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NEW GALL MIDGES (DIPTERA: CECIDOMYIIDAE) INFESTING NATIVE AND INTRODUCED *SOLANUM* SPP. (SOLANACEAE) IN AUSTRALIA

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Summary

KOLESIK, P., MCFADYEN, R. E. C. & WAPSHERE, A. J. (2000) New gall midges (Diptera: Cecidomyiidae) infesting native and introduced *Solanum* spp. (Solanaceae) in Australia. *Trans. R. Soc. S. Aust.* **124**(1), 31-36, 31 May, 2000.

Three new *Asphondylia* species are described from five *Solanum* species in New South Wales and Queensland, Australia. *Asphondylia sturtiana* Kolesik sp. nov. induces a stem swelling on *Solanum sturtianum* F. Muell., an Australian native plant with fruits toxic to sheep and cattle. *Asphondylia paucidentata* Kolesik sp. nov. causes fruit galls on the native *Solanum aviculare* G. Forster and *Solanum linearifolium* Geras. ex Symon, and *Asphondylia obscura* Kolesik sp. nov. causes fruit galls on *Solanum chenopodioides* Lam. and *Solanum physalifolium* Rusby var. *nitidibaccatum* (Bitter) Edmonds, native South American plants that have become weeds in Australia. The newly described gall midges limit reproduction of their host plants.

KEY WORDS: Diptera, Cecidomyiidae, *Asphondylia*, *Solanum aviculare*, *Solanum chenopodioides*, *Solanum linearifolium*, *Solanum physalifolium* var. *nitidibaccatum*, *Solanum sturtianum*, Australia.

Introduction

Solanum elaeagnifolium Cav., silverleaf nightshade, indigenous to central and south-western North America and temperate South America, is a weed of cultivation and disturbed land in New South Wales, Victoria and South Australia (Parsons & Cuthbertson 1992). It is a major weed in South Africa where it has been a target of biological control since the 1970s (Olckers & Zimmermann 1995). Biological control has been considered in Australia but no agents have been introduced (Wapshere 1988). Consequently, there is a continuing interest in insects attacking *S. elaeagnifolium* and other similar *Solanum* species, whether native or introduced. The cecidomyiid species described here were collected in the course of investigations into insects as biological control agents of *Solanum* spp. in Australia.

Solanum sturtianum F. Muell., thargomindah nightshade, is a shrub occurring in central-western Western Australia, southern Northern Territory, South Australia, south-western Queensland and north-western New South Wales (Purdie *et al.* 1982). In Queensland, it is more commonly found in the south-west but also occurs in the north (Henderson 1997) after winter rain (P. Jeffreys, Queensland Department of Natural Resources, Charters Towers, pers. comm. 1998). The ripe fruit is reported to be toxic to stressed sheep and cattle (Cunningham *et al.* 1981).

Solanum aviculare G. Forst. and *S. linearifolium* Geras. ex Symon are related species known by the common names of kangaroo apple and mountain kangaroo apple, respectively. Both species occur mainly in New South Wales and Victoria with *S. aviculare* occurring additionally in eastern Queensland, South and Western Australia, Papua New Guinea, New Zealand, Lord Howe Island, Norfolk Island and New Caledonia (Purdie *et al.* 1982). The ripe berries of *S. aviculare* were consumed by Australian Aborigines and the plant has been cultivated as a source of steroidal alkaloids (Purdie *et al.* 1982; Symon 1994; Kittipongpatana *et al.* 1998).

Solanum chenopodioides Lam., known as whitetip nightshade, and *S. physalifolium* Rusby var. *nitidibaccatum* (Bitter) Edmonds are native to South America but are now established in localised populations in the eastern states of Australia with *S. physalifolium* var. *nitidibaccatum* a sporadic weed of agriculture (Purdie *et al.* 1982). In Australia *S. physalifolium* var. *nitidibaccatum* has been mistakenly referred to *S. sarrachoides* Sendtn. ex Mart. (also a South American native) for many years. *Solanum sarrachoides* is now known to occur in Australia only on Montague Island (Lepschi 1996).

The new gall midges belong to the genus *Asphondylia*. Together with *A. anthocercidis* Kolesik from fruit galls on *Anthocercis* spp. (Kolesik *et al.* 1997; Lepschi *et al.* 1999), the new species form a

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natural group of Australian species associated with Solanaceae.

Materials and Methods

The new gall midges were reared on four occasions. In June 1985, adults (males only) of *A. obscura* were reared (by AJW) from fruit galls on *S. chenopodioides* and *S. physalifolium* var. *nitidibaccatum* collected at Mt Tomah, New South Wales. Adults and pupae of *A. paucidentata* were reared (by AJW) from fruit galls on *S. linearifolium* collected at Boyd Tower, New South Wales, in November 1985 and on *S. aviculare* collected in Bunya Mountains, Queensland, in January 1986. Larvae, pupae and adults of *A. sturtiana* were reared (by RECM) from stem swellings on *S. sturtianum* collected near Charters Towers, Queensland, in September 1998. The taxonomy in this paper is the responsibility of PK. Canada balsam mounts of the specimens for microscopic examination were prepared according to the technique outlined by Kolesik (1995). The type series are deposited in the Australian National Insect Collection, Canberra (ANIC).

Genus *Asphondylia* Loew, 1850

Loew, 1850; Dipterologische Beiträge, 1850: 21 and 47 (as subgenus of *Cecidomyia* Meigen, 1803)

Type species: *Cecidomyia sarothamni* Loew, 1850: 1 ♀, 38 (des. Karsch, 1877).

Asphondylia is one of the largest genera of Cecidomyiidae occurring worldwide with about 260 species known (Gagné 1994). It contains species that have a ventrodistal spur on the first tarsomere, the ovipositor with large basal lobes, the last four female flagellomeres progressively shortened, the gonocoxite bearing a ventroapical lobe and a dorsally situated gonostylus that is about as wide as long with two basally merged teeth.

Asphondylia sturtiana Kolesik sp. nov (FIGS 1-13)

Holotype: ♂, Gregory Highway, 52 km south of Charters Towers, Queensland (20° 25' S, 146° 12' E), reared from stem swelling on *Solanum sturtianum* F. Muell., gall collected ix.1998, R. E. C. McFadyen, 6176 (ANIC).

Paratypes: ♂, 6 ♀♀, 3 pupal skins, 2 larvae (with pupal skins inside), same data.

Male (Figs 1 - 5)

Colour: antennae brown, eyes dark-brown, palpi grey, thorax dark-brown, abdomen with non sclerotised parts red and sclerotised parts dark-brown, legs grey with dark-brown setae, genitalia dark-brown.

Head: Antenna: scape cylindrical, only slightly widened distally, length 1.7 x breadth at distal end, 1.7 - 2.0 x length pedicel; pedicel slightly wider than long; first flagellomere 1.9 - 2.1 x length scape, flagellomeres evenly cylindrical, circumfila dense, equally distributed along segments. Eye facets close together, spheroid, eye bridge 8 - 11 facets long. Frons with 16 – 20 setae per side. Labella crescent shaped, laterally with 7 - 10 setae, setulose. Maxillary palpus 3 segmented, segments successively and progressively longer.

Thorax: Wing length 3.0 mm (range 2.9 – 3.0, n = 2), width 1.2 mm (1.1 – 1.2), R_1 interrupted proximally to arculus, with strongly sclerotised prominsion anterior to arculus. Ventrodistal spur on first tarsomere bent at midlength at right angle. Claws of all legs similar in size and shape, as long as empodia.

Abdomen: Genitalia: ventroapical lobes on gonocoxites short; teeth on gonostylus equal in size, large, symmetrical in posterior view; pedeagus tapered distally; cerci large, hemispherical, setose, setulose; hypoproct with several setae in distal half, setulose.

Female (Figs 6 - 9)

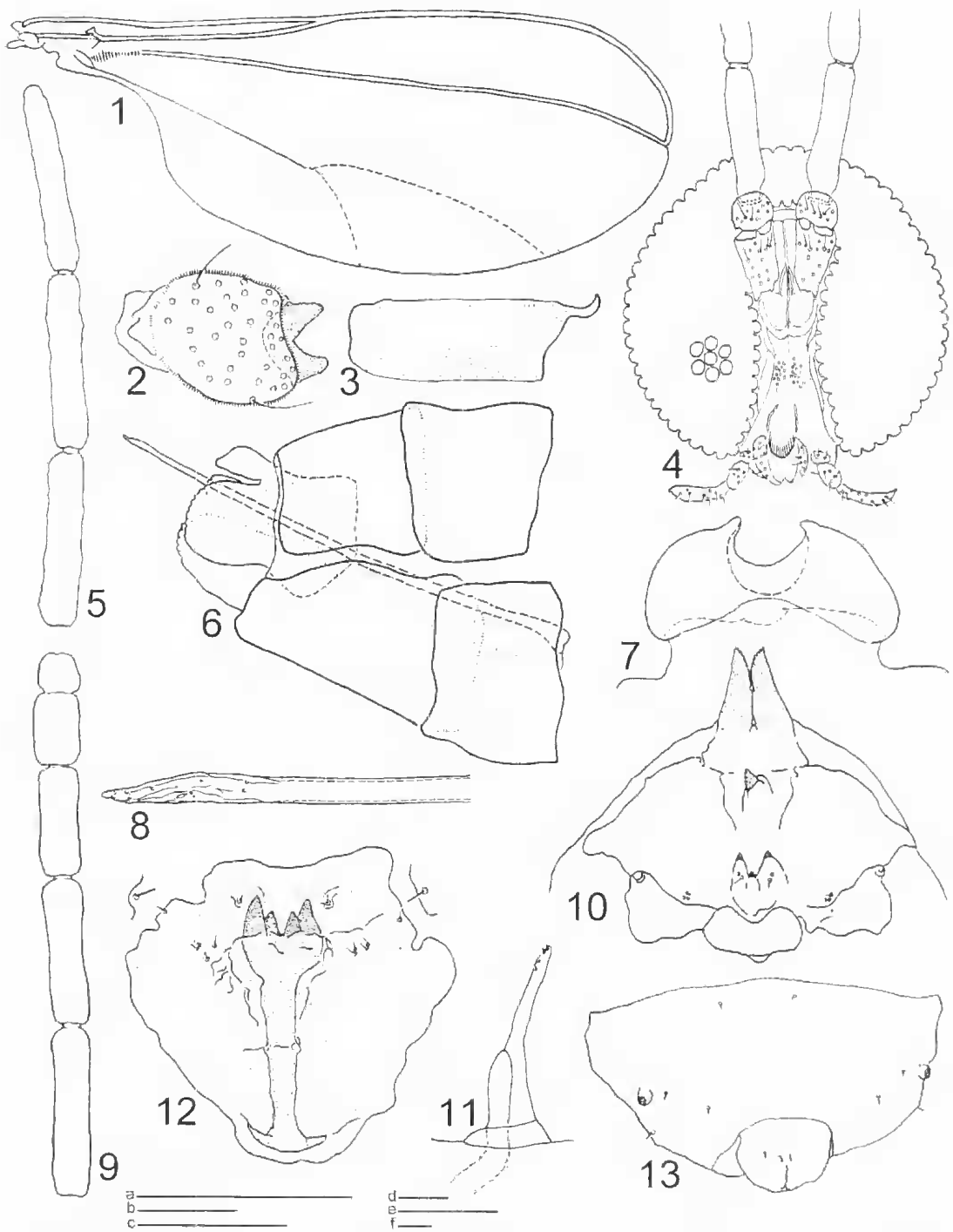
Colour as in male. Frons with 19 - 20 setae per side. Circumfila sparser than in male. Wing length 3.4 mm (3.3 - 3.6, n = 6), width 1.4 mm (1.3 - 1.4). Seventh abdominal sternite 1.8 x (1.6 - 2.0) length sixth. Genitalia: ovipositor 1.9 x (1.8 - 2.0) length seventh sternite; basal lobes with small, distal processes in dorsoventral view, densely covered with long setulae. Other characters as in male.

Pupa (Figs 10, 11)

Colour: antennal horns, frontal horns, abdominal spines dark brown, rest of body light-brown. Length 3.0 mm (2.8 - 3.3, n = 3). Antennal horns serrated along entire inner edge, 278 µm (266 – 289) long, with small free space between them basally. One upper and three lower frontal horns. Prothoracic spiracle slightly curved at midlength, basal third about 3 x width terminal third, terminal third setose, trachea reaching midlength. Abdominal dorsal spines simple, straight, 2 – 3 pairs on last segment curved laterally.

Larva (Figs 12, 13)

Colour: orange-red. Length 2.2 mm (2.1 – 2.3, n = 3). Head capsule with no posterolateral extensions.



Figs 1-13. *Asphondylia sturtiana* sp. nov. 1-5 male, 6-9 female, 10, 11 pupa, 12, 13 larva. Fig. 1. Wing. Fig. 2. Gonostylus in posterior view. Fig. 3. First tarsomere of middle leg. Fig. 4. Head in frontal view. Fig. 5. Last three flagellomeres. Fig. 6. End of abdomen in lateral view. Fig. 7. Basal lobes on ovipositor in dorsal view (setae omitted). Fig. 8. End of ovipositor in lateral view. Fig. 9. Last five flagellomeres. Fig. 10. Anterior part in ventral view. Fig. 11. Prothoracic spiracle. Fig. 12. Sternal spatula with adjacent papillae. Fig. 13. Last two abdominal segments in dorsal view. Scale bars: a = 1 mm (Fig. 1); b = 50 µm (Figs 2, 11); c = 100 µm (Figs 3, 8); d = 100 µm (Fig. 4); e = 100 µm (Figs 5-7, 9, 12, 13); f = 100 µm (Fig. 10).

Spatula with four anterior teeth, inner pair smaller than outer, shaft long and narrow, broadened both at midlength and base, surrounded anteriorly and laterally by extensive pigmented area. Each side of spatula with two pairs of lateral papillae, all setose. On the only specimen with undamaged terminal part, three setose terminal papillae.

Gall and biology

This gall midge induces a stem swelling on *Solanum sturtianum*, 5 - 20 mm long and 6 - 8 mm wide, not different in colour from normal stems. Inside the swelling are several chambers, each occupied by one larva. Pupation takes place within the gall.

Etymology

The name is derived from the specific name of the host plant.

Asphondylia paucidentata Kolesik sp. nov.
(FIGS 14-23)

Holotype: ♂, Bunya Mtns, Queensland (26° 53' S, 151° 37' E), reared from fruit galls on *Solanum aviculare* G. Forster, gall collected 24.i.1986, A. J. Wapshere, 6177 (ANIC).

Paratypes: 2 ♂♂, ♀, same data; 3 ♂♂, 4 pupal skins, Boyd Tower, New South Wales (34° 02' S, 150° 03' E), reared from fruit galls on *Solanum linearifolium* Geras. ex Symon, gall collected 29.xi.1985, A. J. Wapshere.

Male (Figs 14 - 19)

Wing length 3.3 mm (range 3.2 - 3.4, n = 6), width 1.3 mm (1.2 - 1.3). Genitalia in dorsoventral view: gonostylus 1.4 x (n = 2) longer (teeth included in measurement) than wide, distal edge slightly concave to straight, teeth on gonostylus asymmetric. Spur on first tarsomere bent gradually at 45 - 60°. Other characters as in *A. sturtiana*

Female (Figs 20, 21)

Wing length 3.7 mm (n = 1), width 1.4 mm. Basal lobes on ovipositor with no apparent distal processes in dorsoventral view. Otherwise as in *A. sturtiana*.

Pupa (Figs 22, 23)

Length 4.2 mm (3.5 - 4.7, n = 4). Antennal horns 373 µm (360 - 385) long, with 3 - 4 teeth at the midlength of inner edge, otherwise smooth, closely attached to each other along entire length. Prothoracic spiracle strongly curved at midlength, basal third about 4 x width terminal third. Otherwise as in *A. sturtiana*.

Larva unknown.

Gall and biology

This gall midge causes a deformation of fruits on *Solanum aviculare* and *S. linearifolium*, similar to that caused by *Asphondylia anthocercidis* Kolesik on *Anthocercis littorea* Labill. (Solanaceae) (Kolesik *et al.* 1997) and *A. anisantha* Endl. (Lepschi *et al.* 1999), and *Asphondylia obscura* sp. nov. on *S. physalifolium* var. *nitidibaccatum* and *S. chenopodioides*. Pupation takes place within the gall.

Etymology

The name *paucidentata* is a compound Latin adjective from *paucus* and *dentis*, meaning "few" and "tooth", referring to the small number of teeth on the pupal antennal horns.

Asphondylia obscura Kolesik sp. nov.
(FIGS 24-29)

Holotype: ♂, Mt Tomah, New South Wales (33° 33' S, 150° 25' E), reared from fruit galls on *Solanum physalifolium* Rusby var. *nitidibaccatum*, gall collected 4.vi.1985, A. J. Wapshere, 6178 (ANIC).

Paratypes: 3 ♂♂, same data; 5 ♂♂, same data but from fruit galls on *Solanum chenopodioides* Lam.

Male (Figs 24 - 29)

Wing length 3.5 mm (range 3.1 - 3.8, n = 9), width 1.4 mm (1.2 - 1.5). Genitalia in dorsoventral view: gonostylus 1.7 - 1.8 x (n = 3) longer than wide, distal edge strongly concave. Other characters as in *A. paucidentata*.

Female, *pupa*, *larva* unknown.

Gall and biology

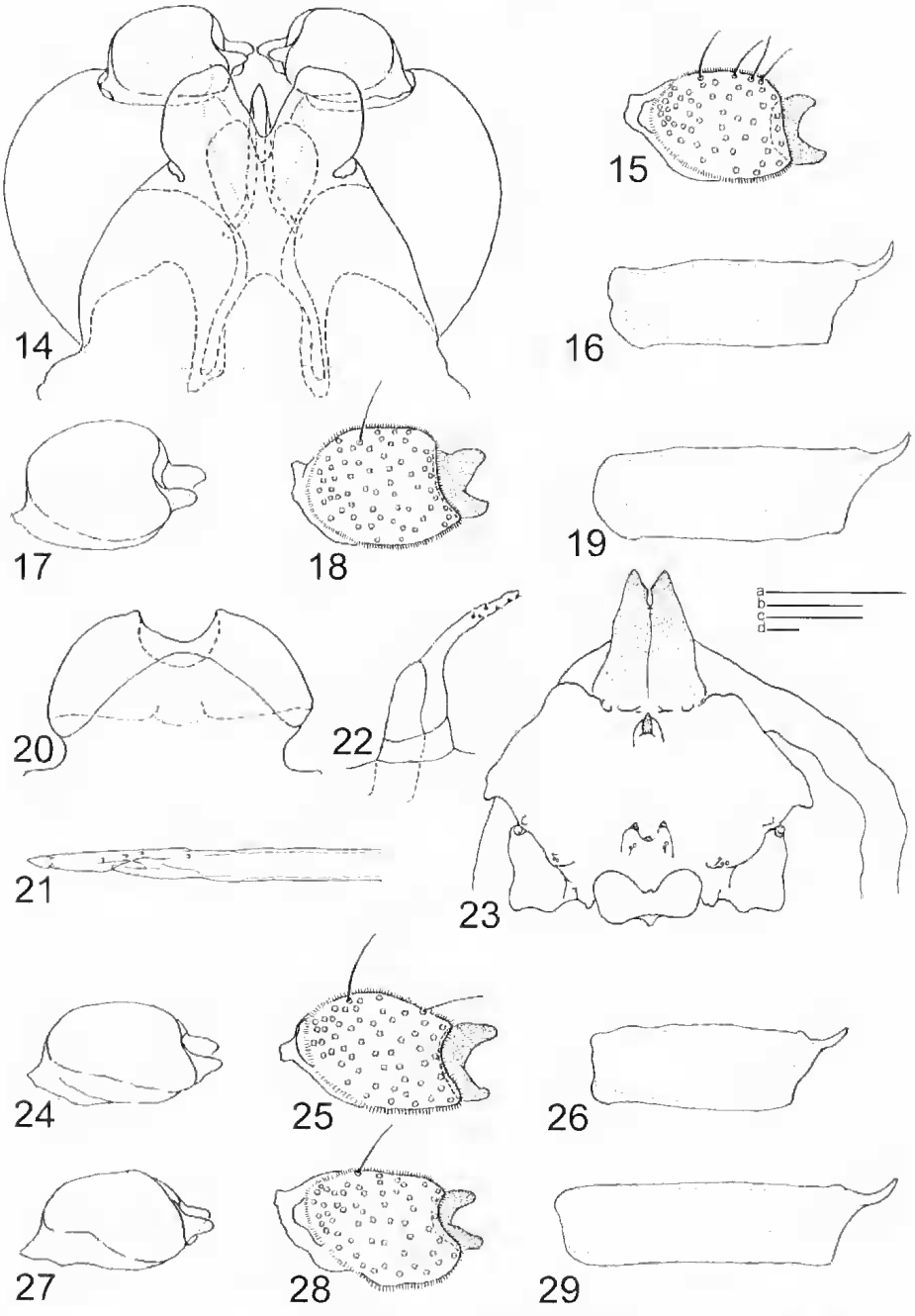
The gall midge causes a fruit gall on *Solanum physalifolium* var. *nitidibaccatum* and *S. chenopodioides*, similar to galls of *A. paucidentata* and *A. anthocercidis*. Pupation takes place within the gall.

Etymology

The name means "obscure" in Latin, referring to the fact that the gall midge was found on non-native plants and therefore its primary host and original geographical distribution are ambiguous.

Remarks

The three new species are morphologically close to each other and to *Asphondylia anthocercidis*, a species that causes fruit galls on *Anthocercis littorea* Labill. (Kolesik *et al.* 1997) and *Anthocercis anisantha* Endl. in Western Australia (Solanaceae) (Lepschi *et al.* 1999). Together, these four species form a natural group associated with plants of the



Figs 14-23. *Asphondylia punctidentata* sp. nov. 14-19 male, 20, 21 female, 22, 23 pupa. Fig. 14. Genitalia in dorsal view. Fig. 15. Gonostylus in posterior view. Fig. 16, First tarsomere of middle leg. Fig. 17. Gonostylus in dorsal view. Fig. 18. Gonostylus in posterior view. Fig. 19. First tarsomere of middle leg. Fig. 20. Basal lobes on ovipositor in dorsal view (setae omitted). Fig. 21. End of ovipositor in lateral view. Fig. 22. Prothoracic spiracle. Fig. 23. Anterior part in ventral view. Specimens in 17 & 18 reared from *Solanum linearifolium*, remaining from *Solanum aviculare*

Figs 24-29. Male of *Asphondylia obscura* sp. nov. Fig. 24, Gonostylus in dorsal view. Fig. 25. Gonostylus in posterior view. Fig. 26. First tarsomere of middle leg. Fig. 27. Gonostylus in dorsal view. Fig. 28. Gonostylus in posterior view. Fig. 29. First tarsomere of middle leg. Specimens in 24-26 reared from *Solanum sarrachoides*, 27-29 from *Solanum chenopodioides*. Scale bars: a = 100 µm (Figs 14, 16, 19, 21, 26, 29); b = 50 µm (Figs 15, 17, 18, 22-25, 27, 28); c = 100 µm (Fig. 20); d = 100 µm (Fig. 23).

family Solanaceae that is morphologically distinguishable from other known Australian *Asphondylia* spp. by the long, cylindrical antennal scape, three lower frontal pupal horns, a setose pupal prothoracic spiracle and long-shafted larval spatula with four anterior teeth. *Asphondylia anthocercidis* differs from the three new species in the gonostylus being narrow in dorsoventral view, in having a narrow and shallow posterior incision on the basal lobes on the ovipositor when viewed dorsoventrally and the smooth antennal horns on the pupa. *Asphondylia spurliana* can be distinguished from *A. paucidentata* by the ventroapical spur on the first tarsomere being bent at a right angle, basal lobes on the ovipositor ending in small processes, pupal antennal horns being serrate along the entire inner edge and only a slightly-bent prothoracic spiracle in the pupa as opposed to the ventroapical spur being bent at 45 – 60°, basal lobes on the ovipositor with no obvious processes, pupal antennal horns with a small number of teeth in the middle of the inner edge and a strongly-bent prothoracic spiracle in the pupa, respectively. *Asphondylia paucidentata* differs from *A. obscura* sp. nov. in the ratio between the length and the width of the gonostylus in the dorsoventral view being 1.4 as opposed to 1.7 - 1.8 for *A. obscura*.

Solanum chenopodioides and *S. physalifolium* var. *nitidibaccatum*, the host plants of *A. obscura*, are not native to Australia. Although no *Asphondylia* has been known to be associated with these plants in their native South America (Gagné 1994), it is currently not possible to determine the primary host and the area of distribution of this gall midge due to the limited knowledge of gall midge fauna associated with Solanaceae in Australia and South America.

The new species restrict reproduction and growth of their respective plant hosts by turning the fruit into a seedless gall and deforming the stem. Further investigation is needed, though, to clarify the role of fruit-galling *A. paucidentata* and *A. obscura* in the pollination of their hosts, a phenomenon assumed in *A. anthocercidis* (Kolesik *et al.* 1997).

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